From: Medical Innovations <med.tech.icmr@gmail.com>
Date: 21 February 2018 at 17:20
Subject: Final Report on MozziQuit – Medical Device for Prevention of Diseases
To: **Orwin Noronha** orwinnoronha@gmail.com

Dear Mr. Noronha,

We are forwarding herewith the Final Report on Evaluation of MozziQuit device a Medical Device made by you for Prevention of Diseases as submitted by Dr. S.K. Ghosh, Scientist – G of National Institute of Malaria Research (ICMR), Bangalore to Director of Indian Council of Medical Research, New Delhi for further action.

This is for your information.

With sincere regards,
Dr Meenakshi Sharma
Scientist -E,
Div of NCD/ITR
ICMR Hqrs, New Delhi

---------- Forwarded message ----------
From: **Susanta Ghosh** <ghoshnimr@gmail.com>
Date: 21 February 2018 at 13:28
Subject: MoziQuit Report
To: "Dr. Neena Valecha" <neenavalecha@gmail.com>, Medical Innovations <med.tech.icmr@gmail.com>

Madam,

We are sending the report of MoziQuit - a mosquito trapping device. This is for your kind information and needful. It is to be mentioned that SAC of NIMR has recommended for multicentric trials of such devices.
With regards,

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Dr S K Ghosh, Scientist G
National Institute of Malaria Research (ICMR)
Nirmal Bhawan, Poojanahalli, Kannamangala Post
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Field evaluation of MozziQuit, a mosquito trapping device for the surveillance of mosquito vectors in Mangalore city, Karnataka.

FINAL REPORT

ICMR-National Institute of Malaria Research

Field Unit

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Product Evaluation

MoziQuitt – a mosquito trapping device

Executive Summary

"MozziQuit" a mosquito trapping device developed by M/s Leowin Solutions Private Limited, Mangalore, Karnataka, India was evaluated to find the possibility of its use for the surveillance of mosquito vectors in the field. The study was carried out during January- March 2017 in dry season and September- October 2017 in wet season in construction sites in Mangalore city of Karnataka. Based on mosquito breeding and adults resting, construction sites were selected and traps were placed indoor and outdoor. The traps were set up and operated according to the suggested manufacturer's recommendations for 24 hours for two nights in a month. Parallel conventional traps were placed for comparison.

MozziQuit, traps Anopheles mosquitoes especially malaria vector *Anopheles stephensi*, *Culex* mosquitoes especially human filariasis vector *Culex quinquefasciatus* and JE vector *Cx. tritaenorhynchus*, Aedes mosquitoes especially Dengue vector *Aedes aegypti* and Chikungunya vector *Ae. albopictus*. Over all the mosquitoes including vector mosquitoes trapped in MozziQuit traps were almost equal or more than conventional traps. Mozziquit traps may be used as vector mosquito surveillance tool.

Background

Over the past two decades significant improvements have been made in mosquito trapping technology. Various models incorporating propane as a power and heat source, as well as blends of carbon dioxide, octenol and other attractants have been developed that catches greater number of mosquitoes and species (Kline, 2002). An extensive database on the performance of a large variety of mosquito traps have been developed (Smith and Shaffer 2000, Smith 2002, Smith *et al*. 2002, Smith and Walsh 2003, Smith *et al*. 2006a, 2008). In present study mosquito trap device "MozziQuit" developed by M/s Leowin Solutions Private Limited, Mangalore, Karnataka, India was evaluated for the effective surveillance of mosquito vectors in the field.

Objectives:

I. Whether the candidate evaluation trapping device could be able to trap mosquitoes, especially malaria vector *Anopheles stephensi*, dengue/ chikungunya vector (s) *Aedes aegypti* and *Aedes albopictus* and human filariasis vector *Culex quinquefasciatus*

II. To find out the differences in densities of mosquitoes that was trapped in candidate device in comparison to conventional light traps.

Methodology:

The study was carried out in dry and wet seasons in Mangalore city especially in the constructions sites where most of the malaria cases are reported. The traps were evaluated during January- March 2017 in dry season and September- October 2017 in wet season.

Dry season:

Study area:

Two areas one including Derebail, Nanthoor and Pumpwell & surroundings and another including Mukyaprana temple Road (Bandar), Bolar and Valencia in Mangalore city were selected for the study. Based on mosquito breeding and adults resting, in first area four construction sites namely Father Muller car parking, Kankanady, Onyx Gold palace Pumpwell, Fern hill Nanthoor and Harsha, Derebail and in second area Pauline, Valencia, Green county, Bolar, Chetan, Bolar and Ganga Yamuna, Bandar were selected for the study.

Placement of traps:

On first day in first area four candidate traps (MozziQuit) one in each construction site were placed. Out of these two were placed outdoor and two indoor. In second area four conventional light traps one in each construction were placed. Out of these two were placed outdoor and two indoor. On third day the placement was voice-versa ie.in first area four conventional light traps one in each construction were placed and outdoor place were replaced by indoor. In second area four candidate traps (MozziQuit) one in each construction site were placed and outdoor place were replaced by indoor. The traps were set up and operated according to the suggested manufacturer's recommendations for 24 hours for two nights in a month.

In another set of experiment in dry season one construction site namely A. J. Engineering College, Kulur was selected for the study. Both evaluation and conventional traps were placed at same construction site. During February on 21-22 night one evaluation trap was placed indoor and one conventional trap outdoor. Second night on 23-24 March the traps were placed voice -versa. Evaluation trap was placed outdoor and conventional trap indoor.

In the month of March two evaluation traps and four conventional traps were placed indoor and outdoor for two nights on 20-21 and 22-23. On the night of 23-24 March two evaluation and two conventional traps were placed indoor and outdoor.

Wet season:

Study sites:

Eight construction sites based on mosquito breeding and adults resting in two areas were selected for the study. In first area four construction sites namely Palm hills,Kulshekhera, Classic Ruby, Shaktinagar, Long Field,Yeyadi, Palace garden,Bejai and in second area D-3 construction,Urva store, Judges Quarters, Lalbagh, Zilla Panchayat,Urva store and Nand Gokula, Bejai were selected for the study.

Placement of traps:

On first day in first area four candidate traps (MozziQuit) one in each construction site were placed. Out of these two were placed outdoor and two indoor. In second area four conventional light traps one in each construction were placed. Out of these two were placed outdoor and two indoor. On third day the placement was voice-versa ie.in first area four conventional light traps one in each construction were placed and outdoor

place were replaced by indoor. In second area four candidate traps (MozziQuit) one in each construction site were placed and outdoor place were replaced by indoor. The traps were set up and operated according to the suggested manufacturer's recommendations for 24 hours for two nights in a month.

In another set of experiment in wet season two construction sites namely Ocean US, Pandeshwera and Elixire enclave, Bolar were selected for the study. Both evaluation and conventional traps were placed at same construction site. One evaluation trap was placed indoor and one conventional trap outdoor in both the construction sites. The placement was voice-versa in each consecutive night i e. indoor was placed outdoor and outdoor was placed indoor.

Mosquitoes from the traps were collected in the morning at 0600 AM and in the evening at 0600 PM. Mosquitoes collected in each trap after 12 and 24 hours were pooled. Collected mosquitoes were identified for the species following the identification key of anophelines (Nagpal & Sharma,1995) and culicines (Reuben *et al*.,1994, Barraud, 1934). Vector, non vector and damaged mosquitoes and other insects were separated.

Technology of the "MozziQuit":

It is an electrical device especially developed to attract, trap and kill mosquitoes. Food grade proprietary additives are added to the raw material of plastic of one of the casing part of MozziQuit while producing the same through injection molding machine. MozziQuit when switched on emits glowing effect mainly due to the food grade proprietary additives added in its casing parts in combination of light which attracts mosquitoes towards the device. Once the mosquitoes are attracted towards the device the temperature equivalent to body/ blood nerves temperature generated by MozziQuit will make the mosquitoes to come near the trapping zone which is on the top portion of the device. The vacuuming technology within the device will suck the mosquitoes from the trapping zone forcibly inside the trap making the mosquitoes to pass through the perforated holes which is killing zones within the device. Dead mosquitoes will get collected in the removable collection container which is at the bottom side of the device.

MozziQuit operates with electricity. MozziQuit attracts, traps and kills mosquitoes at less than 5 paisa per day operating cost for power without use of any chemicals or mats or liquid refills or consumables or smokes or smell or ash or fumes.

How to use MozziQuit:

Connect to the power source and on the switch. MozziQuit device needs to be placed at a height between 2 feet to 4 feet from ground level in rooms or halls or toilets or outside under shade/cover to protect from the rain water. Performance of the MozziQuit is excellent in the darkness. Empty the removable collection container every day in the morning otherwise dead mosquitoes will be eaten by the ants.

Statistical Analysis

The data received from this study was analyzed by student `t' test using the VassarStats (vassarstat.net) analysis tool. Value > 0.05 was considered significant.

Findings:

Dry season:

Total number of mosquitoes trapped per night per trap in evaluation and conventional traps during dry season in first set of experiment are given in table1. A total no. of 527 mosquitoes belonging to 7 species i.e. *An. stephensi, Anopheles va*gus, *Cx. quinquefasciatus*, *Cx tritaenorhynchus*, *Cx. gelidus*, *Cx. sitiens* and *Armigeres theobaldi* were trapped in evaluation and conventional traps. *Cx. quinquefasciatus* was the predominant species followed by *Ar. theobaldi*, *An. stephensi*, *Cx. gelidus* and *Cx. tritaenorhynchus*. Only two specimens one each of *An. vagus* and *Cx. sitiens* were trapped during March in evaluation trap. The number of mosquitoes trapped per night per trap in evaluation traps (18.04) were more than 3.92 in conventional traps. Anopheles, Culex and Armegeres all three types of mosquitoes were more in evaluation traps than conventional traps. The damaged mosquitoes were also more in evaluation traps (2.83) than conventional traps (0.04). No *Aedes* mosquitoes were trapped in both evaluation and conventional traps in first set of experiment during dry season in construction sites in Mangalore city. *An. stephensi, Cx. quinquifasciatus,* and *Cx. tritaenorhynchus* are well established vector mosquito species. *An. stephensi* is the vector species of malaria, *Cx. quinquefasciatus* is of human filariasis and *Cx. tritaenorhynchus* is of Japanese Encephalitis in India. Number of vector mosquitoes trapped per night per trap in evaluation traps (11.71) were more than 3.29 in conventional traps. Human filariasis vectors were trapped maximum followed by malaria and JE vectors. *An. stephensi* and *Cx. quinquefasciatus* were more in evaluation traps than conventional traps during February and March. *Cx. tritaenorhynchus* were more in evaluation traps than conventional traps during all the three months studied.

Number of mosquitoes trapped per night per trap in evaluation traps and conventional traps in second set of experiment at A. J. Engineering construction site in Mangalore city during dry season are given in table2. A total no. of 8 mosquito species namely *An. stephensi*, *Cx. quinquefasciatus*, *Cx. tritaenorhynchus*, *Cx. gelidus*, *Culex sitiens ,Ae.albopictus, Ae.vitatus* and *Ar. theobaldi* were trapped. Mosquitoes trapped per night per trap in Mozziquit evaluation traps were more than conventional traps. Vector mosquitoes were also more in evaluation traps (14.35) than conventional traps (5.48) (p >0.05).

Wet season:

Number of mosquitoes trapped per night per trap in evaluation and conventional traps during wet season in first set of experiment are given in table3. A total no. of 372 mosquitoes comprising 9 species namely *An. stephensi*, *Anopheles jamsi*, *Cx. quinquefasciatus*, *Cx. tritaenorhynchus*, *Cx. gelidus*, *,Ae.aegypti, Ae.vitatus, Mansonia annulifera* and *Ar. theobaldi* were trapped in evaluation and conventional traps. The maximum trapped mosquitoes were culex followed by Anopheles, Armigeres, Aedes and Mansonia. The no. of mosquitoes trapped per night per trap in evaluation traps 10.92 were more than 4.58 in conventional traps (p >0.05). Vector mosquitoes were also more in evaluation traps than conventional traps. However, Aedes mosquitoes, vectors of dengue and Chikungunya especially Ae. aegypti trapped were almost equal in evaluation and conventional traps.

Mosquitoes trapped per night per trap in evaluation traps and conventional traps in second set of experiment are given in table4. Total no. of mosquitoes and vector mosquitoes were more in evaluation traps than conventional traps.

The no. of mosquitoes trapped per night per trap in dry season were more than wet season. Anopheles mosquitoes trapped in wet season were more than dry season however, culex mosquitoes trapped in dry season were more than wet season. In wet season Aedes mosquitoes especially Aedes aegypti vectors of dengue fever were also trapped. No. of Aedes mosquitoes trapped per night per trap in evaluation and conventional traps are almost equal in evaluation and conventional traps. Mansonia mosquitoes were also trapped in evaluation and conventional traps in wet season.

In addition to mosquitoes, other insects were also trapped and more in MozziQuit traps than conventional traps.

Thus the candidate evaluation trap MozziQuit, traps Anopheles mosquitoes especially malaria vector *An.stephensi*, Culex mosquitoes especially human filariasis vector *Cx. quinquefasciatus* and JE vector *Cx.tritaenorhynchus*, Aedes mosquitoes especially

Dengue vector Ae. aegypti and Chikungunya vector *Ae. albopictus* and nuaisance mosquitoes Armigeres. Over all the mosquitoes including vector mosquitoes trapped in MozziQuit traps were almost equal or more than conventional traps. Hence, candidate evaluation trap MozziQuit is almost equal or superior than all type of conventional traps used. More over Mozziquit trap is easy to handle and transportation. The major drawback in Mozziquit trap is that mosquito damage is more and it becomes difficult to identify damaged mosquitoes if used for vector surveillance tool. Further Mozziquit trap is only light operated and will not work at the time of power failure or if there is no current in the area. However, all conventional traps used were Battery operated.

Conclusion:

Mozziquit traps may be used as vector mosquitoes surveillance tool if their design may be changed in such a way that trapped mosquitoes should not damage and it may be operated with battery if current is not available.

Acknowledgement:

The investigators thankfully acknowledge the contractors of all selected construction sites for their constant support. Thanks are also due to the staff of NIMR, Field Unit, Bangalore who executed, monitored the entire process of the study. Due acknowledgement is to Dr. Arun Kumar, District Vector Borne Disease Control Officer, Dakshina Kannada District, Mangalore who helped in the study. Financial support was rendered by ICMR, New Delhi, India.

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Table1. Mosquitoes trapped in evaluation and conventional traps in first set of experiment in construction sites in Mangalore city during dry season.

Type of Mosquitoes	No. of mosquitoes trapped/night/trap		
	Evaluation traps	Conventional traps	Total
Total mosquitoes	18.04 (433)	3.92(94)	10.98(527)
Anopheles	0.79 (19)	0.17(4)	0.48(23)
Culex	11.08(266)	3.33(80)	7.21(346)
Armigeres	3.33(80)	0.37(9)	1.85(89)
Damaged mosquitoes	2.83(68)	0.04(1)	1.44(69)
Vector mosquitoes	11.71(281)	3.29(79)	7.50(360)
An. stephensi	0.75(18)	0.17(4)	0.46(22)
Cx. quinquefasciatus	10.79(259)	3.04(73)	6.92(332)
Cx. tritaenorhynchus	0.17(4)	0.08(2)	0.12(6)
Non vector mosquitoes	3.50(84)	0.58(14)	2.04(98)
An. vagus	0.04(1)	0	0.02(1)
Cx gelidus	0.08(2)	0.21(5)	0.14(7)
Cx.sitiens	0.04(1)	0	0.02(1)
Ar. theobaldi	3.33(80)	0.37(9)	1.85(89)

Figures in parentheses indicate no. of mosquitoes trapped.

No. of nights-6, No. of traps- 4evaluation and 4 conventional in each night

Table2. Mosquitoes trapped in evaluation and conventional traps in second set of experiment in construction sites in Mangalore city during dry season.

Type of Mosquitoes	No. of mosquitoes trapped/nigh/trap		
	Evaluation traps	Conventional traps	Total
Total mosquitoes	19.72(789)	8.33(500)	12.89(1289)
Anopheles	0.10(4)	0.08(5)	0.09(9)
Culex	14.92(597)	7.52(451)	10.48(1048)
Aedes	(0.02 (1)	0.02(1)	0.02(2)
Armigeres	0.95(38)	0.60(36)	0.74(74)
Damaged mosquitoes	3.72(149)	0.12(7)	1.56(156)
Vector mosquitoes	14.35(574)	5.48(329)	9.03(903)
An.stephensi	0.10(4)	0.12(5)	0.09(9)
Cx. quinquefasciatus	13.72(549)	4.25(255)	8.04(804)
Cx. tritaenorhynchus	0.52(21)	1.13(68)	0.89(89)
Ae.albopictus	0	0.02(1)	0.01(1)
Non vector mosquitoes	1.65(66)	2.73(164)	2.30(230)
An. vagus	0	0	0
Cx gelidus	0.67(27)	2.00(120)	1.47(147)
Cx.sitiens	0	0.13(8)	0.08(8)
Ae.vitatus	0.02(1)	0	0.01(1)
Ar. theobaldi	0.95(38)	0.60(36)	0.74(74)

Figures in parentheses indicate no. of mosquitoes trapped.

No. of nights-5, No. of traps- Total 8 evaluation and 12 conventional..

Table 3. Mosquitoes trapped in evaluation and conventional traps in first set of experiment in construction sites in Mangalore city during wet season.

Type of Mosquitoes	No. of mosquitoes trapped/night/trap		
	Evaluation traps	Conventional traps	Total
Total mosquitoes	10.92 (262)	4.58 (110)	7.75 (372)
Anopheles	2.46 (59)	0.62 (15)	1.54 (74)
Culex	6.00 (144)	2.67 (64)	4.33 (208)
Aedes	0.54 (13)	0.62 (15)	0.58 (28)
Mansonia	0.12 (3)	0.04 (1)	0.08 (4)
Armigeres	1.08 (26)	0.62 (15)	0.85 (41)
Damaged mosquitoes	0.71 (17)	0	0.35 (17)
Vector mosquitoes	8.96 (215)	3.79 (91)	6.37 (306)
An. stephensi	2.46 (59)	0.58 (14)	1.52 (73)
Cx. quinquefasciatus	5.83 (140)	2.33 (56)	4.08 (196)
Cx. tritaenorhynchus	0.12 (3)	0.33 (8)	0.23 (11)
Ae. aegypti	0.54 (13)	0.54 (13)	0.54 (26)
Non vector mosquitoes	1.25 (30)	0.79 (19)	1.02 (49)
An. jamsi	0	0.04 (1)	0.04 (1)
Cx gelidus	0.04 (1)	0	0.04 (1)
Ae. vittatus	0	0.08 (2)	0.08 (2)
Mn. annulifera	0.12 (3)	0.04 (1)	0.08 (4)
Ar. theobaldi	1.08 (26)	0.62 (15)	0.85 (41)

Figures in parentheses indicate no. of mosquitoes trapped..

No. of nights-6, No. of traps- 4evaluation and 4 conventional in each night

Table4. Mosquitoes trapped in evaluation and conventional traps in second set of experiment in construction sites in Mangalore city during wet season.

Type of Mosquitoes	No. of mosquitoes trapped/nigh/trap		
	Evaluation traps	Conventional traps	Total
Total mosquitoes	2.58(31)	2.0 (24)	2.29 (55)
Anopheles	0.92 (11)	0.58 (7)	0.75 (18)
Culex	1.0 (12)	0.75 (9)	0.87 (21)
Aedes	0.25 (3)	0.08 (1)	0.17 (4)
Armigeres	0.25 (3)	0.58 (7)	0.42 (10)
Damaged mosquitoes	0.17 (2)	0	0.08 (2)
Vector mosquitoes	2.17 (26)	1.42 (17)	1.79 (43)
An. stephensi	0.92 (11)	0.58 (7)	0.75 (18)
Cx. quinquefasciatus	1.0 (12)	0.75 (9)	0.87 (21)
Ae. aegypti	0.25 (3)	0.08 (1)	0.17 (4)
Non vector mosquitoes	0.25 (3)	0.58 (7)	0.42 (10)
Ar. theobaldi	0.25 (3)	0.58 (7)	0.42 (10)

Figures in parentheses indicate no. of mosquitoes trapped.

No. of nights-6, No. of traps- Total 2 evaluation and 2 conventional